

(51) International Patent Classification<sup>6</sup> :

F16J 1/22, F04B 39/00, 39/14

A1

(11) International Publication Number:

WO 96/03601

(43) International Publication Date:

8 February 1996 (08.02.96)

(21) International Application Number: PCT/PL95/00014

(22) International Filing Date: 26 July 1995 (26.07.95)

(30) Priority Data:

P.304502

28 July 1994 (28.07.94)

PL

(71) Applicant: EDA SPÓŁKA AKCYJNA [PL/PL]; Fabryczna 16, PL-24-320 Poniatowa (PL).

(72) Inventor: MATRASZEK, Stanisław; Słoneczna 1/19, PL-24-320 Poniatowa (PL).

(74) Agent: CZERPAK, Andrzej; Kraczeńska 25/8, P.O. Box 18, PL-24-320 Poniatowa (PL).

(81) Designated States: European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

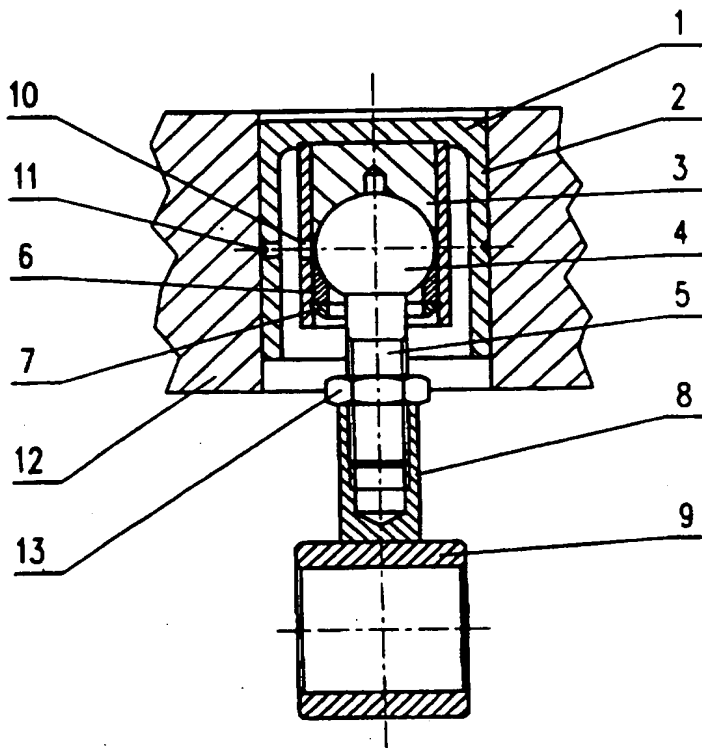
Published

With international search report.

(54) Title: THE PISTON-CONNECTING ROD UNIT WITH AN ADJUSTABLE CONNECTING-ROD AND THE TECHNOLOGY OF MANUFACTURING OF THE PISTON-CONNECTING ROD UNIT

## (57) Abstract

The piston-connecting rod unit with an adjustable connecting-rod has, inside the piston (1) skirt, the holder (2) of the socket (3) of the ball (4) installed on the shaft (5) having, on the opposite side of the ball, a thread fixing the coupling (8) of the connecting-rod (9) foot. The manufacturing technology of the piston-connecting rod unit is that between the piston (1) skirt and the holder (2) brazed to it, the technological bushing is placed up to the half of the height of the holder (2) which protruding part is belled. After the socket (3) has been formed by means of the ball having diameter equal to the diameter of the ball (4), the threaded shaft (5) with ball (4) joined with it, the insert (6) and the washer (7) are inserted and then the technological bushing is taken out. Afterwards, the threaded shaft (5) is screwed into the coupling (8) with the sleeve (9) and the protection from loosening is made by means of gluing or screwing on a lock-nut (13).



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

**THE PISTON-CONNECTING ROD UNIT  
WITH AN ADJUSTABLE CONNECTING-ROD AND  
THE TECHNOLOGY OF MANUFACTURING OF  
THE PISTON-CONNECTING ROD UNIT.**

5

The object of this invention is the piston-connecting rod unit with an adjustable connecting-rod, that may be applied especially in hermetic compressors, as well as the technology of its manufacturing.

10

There is known from the German patent application No. 30 30 319 the connecting-rod of a compressor, especially used in hermetic compressors of coolers, where the piston, fixed on the connecting-rod ball, is joined with the connecting-rod foot through the sectional connecting-rod. The parts of the connecting-rod are  
15 joined together by soldering after the piston-connecting rod sub-assembly has been assembled with the compressor shaft crank-pin in the housing-cylinder block being a monolith.

Such a design does not allow for clearance space adjustment  
20 in the compressor.

There is also known from the Polish patent description 162 054 the ball-and-socket joint piston, in which the ball is connected with the connecting-rod using welding and bonding technologies,  
25 and through the necking of a cylindrical protrusion of an internal part of the piston on the ball, using intermediate flexible insert, the ball and the piston are joined together.

Such a design does not allow to adjust the outer dead centre  
30 of the piston in the compressor's cylinder otherwise than through

dislocation of the cylinder in relation to the compressor's housing, which excludes application a housing and a piston as a one block of a compressor. Furthermore, the design mentioned above requires specialised tools for the necking process and cannot  
35 guarantee that an accurate clearance in the ball-and-socket joint connecting the piston with the connecting-rod is achieved.

The essence of this invention is the piston-connecting rod unit with an adjustable connecting-rod, in which, inside the cup-  
40 like piston skirt, the sleeve-like holder of the socket of the ball installed on the front of the shaft being the frontal part of the connecting-rod, is centrally fixed. The flexible clamping insert, fixed inside the holder by using a ring washer, supports the ball. The shaft on the opposite side of the ball has a thread, whereto the  
45 coupling of the connecting-rod foot is fixed.

The internal diameter of the sleeve-like holder is a little bit larger than the ball's diameter and at least three lubricating holes are placed on its side surface at the height of the ball axis. The piston skirt has, on the cylindrical surface, at least three holes facing the  
50 holes of the holder.

The manufacturing technology of the piston-connecting rod unit is that the piston skirt is brazed to the sleeve-like holder, and then between the piston skirt and the holder, the technological bushing is placed which perfectly fills the space between these two  
55 parts approximately up to the half of the holder's height. Then, after the protruding part of the holder has been belled, the bearing socket is placed into the holder and, using a technological ball having diameter equal to the diameter of the ball, a mating surface of the socket and the ball is being formed. The ball joined with the  
60 threaded shaft, the flexible insert and the ring washer are inserted

into the so manufactured sub-assembly, and after taking out the technological bushing from the space between the piston skirt and the holder, the washer inside the holder is clamped. Then, screwing onto the shaft the threaded coupling of the connecting-rod foot, the outer dead centre of the piston skirt front is set in the cylinder and afterwards the piston-connecting rod unit is integrated. The ball is joined with the shaft with a hard solder. To avoid undesired oxidation, the best results are achieved when a blanket furnace brazing using a copper is applied. Then, the ball is galvanised, preferably a nickel electroplating should be used, and the thickness of the ball's coating should compensate decrease of the ball's diameter during the soldering process. The screw joint of the shaft and the sleeve is protected from loosening by means of gluing or screwing on a lock-nut.

75

The advantage of the present invention lies in minimisation of the clearance space in the compressor through adjustment of the outer dead centre of the piston inside the cylinder as well as possibility of applying in the compressor's design the housing-cylinder sub-assembly being a one block.

80

The object of this invention is shown on the drawing, where Fig. 1 presents the longitudinal section of the piston-connecting rod unit, and Fig. 2 shows the location of the unit in the housing-cylinder sub-assembly of the hermetic compressor.

85

The piston-connecting rod unit with an adjustable connecting-rod in which, inside the cup-like piston 1 skirt there is installed centrally the sleeve-like holder 2 of the socket 3 of the ball 4 being inseparably fixed to the front of the shaft 5 being the

90

frontal part of the connecting-rod. The ball is supported by the flexible clamping insert 6, fixed inside the holder 2 by using a ring washer 7, and the shaft 5 on the opposite side of the ball 4 has a thread, whereto the coupling 8 of the foot of the connecting-rod 9 is fixed. The internal diameter of the sleeve-like holder 2 is a little bit larger than the diameter of the ball 4 and has at least three lubricating holes 10 placed on its side surface at the height of the ball 4 axis. The piston 1 skirt has on the cylindrical surface at least three holes 11, facing the holes 10 of the holder 2.

The manufacturing technology of the piston-connecting rod unit is that the cup-like piston 1 skirt is brazed to the sleeve-like holder 2, and then between the piston 1 skirt and the holder 2, the technological bushing is placed which perfectly fills the space between these two parts approximately up to the half of the height of the holder 2. Then, after the protruding part of the holder 2 has been belled, the bearing socket 3 is placed into the holder 2 and, using a technological ball having diameter equal to the diameter of the ball 4, a mating surface of the socket 3 and the ball 4 is being formed. The ball 4 joined with the threaded shaft 5, the flexible insert 6 and the ring washer 7 are inserted into the so manufactured sub-assembly, and after taking out the technological bushing from the space between the piston 1 skirt and the holder 2, the washer 7 inside the holder 2 is clamped. Afterwards, through screwing the shaft 5 into the threaded coupling 8 of the connecting-rod 9 foot, the outer dead centre of the piston 1 skirt front is set in the cylinder 12 and next the piston-connecting rod unit is integrated. The ball 4 is joined with the shaft 5 with a hard solder, preferably, to avoid oxidation, a blanket furnace brazing using a copper should be applied, and then, the ball 4 is

120 electroplated, preferably with a nickel coating of the thickness compensating decrease of diameter of the ball 4 during the soldering process. The screw joint of the shaft 5 and the sleeve 8 is protected from loosening by means of gluing or screwing on a lock-nut 13.

125

## Claims

1. The piston-connecting rod unit with an adjustable connecting-rod having the connecting-rod with the ball and the sleeve as well as the cup-like piston, is characterized with the following: inside the cup-like piston (1) skirt there is installed centrally the sleeve-like holder (2) of the socket (3) of the ball (4) fixed on the front of the shaft (5) being the frontal part of the connecting-rod and supported by the flexible clamping insert (6), fixed inside the holder (2) by using the ring washer (7), while the shaft (5) has a thread, made on the opposite side of the ball (4), whereto the coupling (8) of the connecting-rod (9) foot is fixed.

2. The piston-connecting rod unit as claimed in claim 1, is characterized by the following features: the internal diameter of the sleeve-like holder (2) is a little bit larger than the diameter of the ball (4) and has at least three lubricating holes (10) placed on its side surface at the height of the ball (4) axis.

3. The piston-connecting rod unit as claimed in claim 1, is characterized by the following features: the piston (1) skirt has on the cylindrical surface at least three holes (11), facing the holes (10) of the holder (2).

4. The manufacturing technology of the piston-connecting rod unit is characterized by the following features: the cup-like piston (1) skirt is brazed to the sleeve-like holder (2), and then between the piston (1) skirt and the holder (2), the technological bushing is placed, which perfectly fills the space between these



30 two parts approximately up to the half of the height of the holder  
(2), and then, after the protruding part of the holder (2) has been  
belled, the bearing socket (3) is placed into the holder (2) and,  
using a technological ball having diameter equal to the diameter of  
the ball (4), a mating surface of the socket (3) and the ball (4) is  
35 being formed, then, the ball (4) joined with the threaded shaft (5),  
the flexible insert (6) and the ring washer (7) are inserted into the  
so manufactured sub-assembly, and after taking out the  
technological bushing from the space between the piston (1) skirt  
and the holder (2), the washer (7) inside the holder (2) is  
40 clamped, and then, screwing the shaft (5) into the threaded  
coupling (8) of the connecting-rod (9) foot, the outer dead centre  
of the piston (1) skirt front is set in the cylinder (12) and finally the  
piston-connecting rod unit is integrated.

45 5. The technology as claimed in claim 4, is characterized  
by that the ball (4) is joined with the shaft (5) with a hard solder,  
preferably, to avoid oxidation, a blanket furnace brazing using a  
copper should be applied, and then, the ball (4) is electroplated,  
preferably with a nickel coating of the thickness compensating  
50 decrease of diameter of the ball (4) during the soldering process.

6. The technology as claimed in claim 4, is characterized  
by that the screw joint of the shaft (5) and the sleeve (8) is  
protected from loosening by means of gluing or screwing on a  
55 lock-nut (13).

1/2

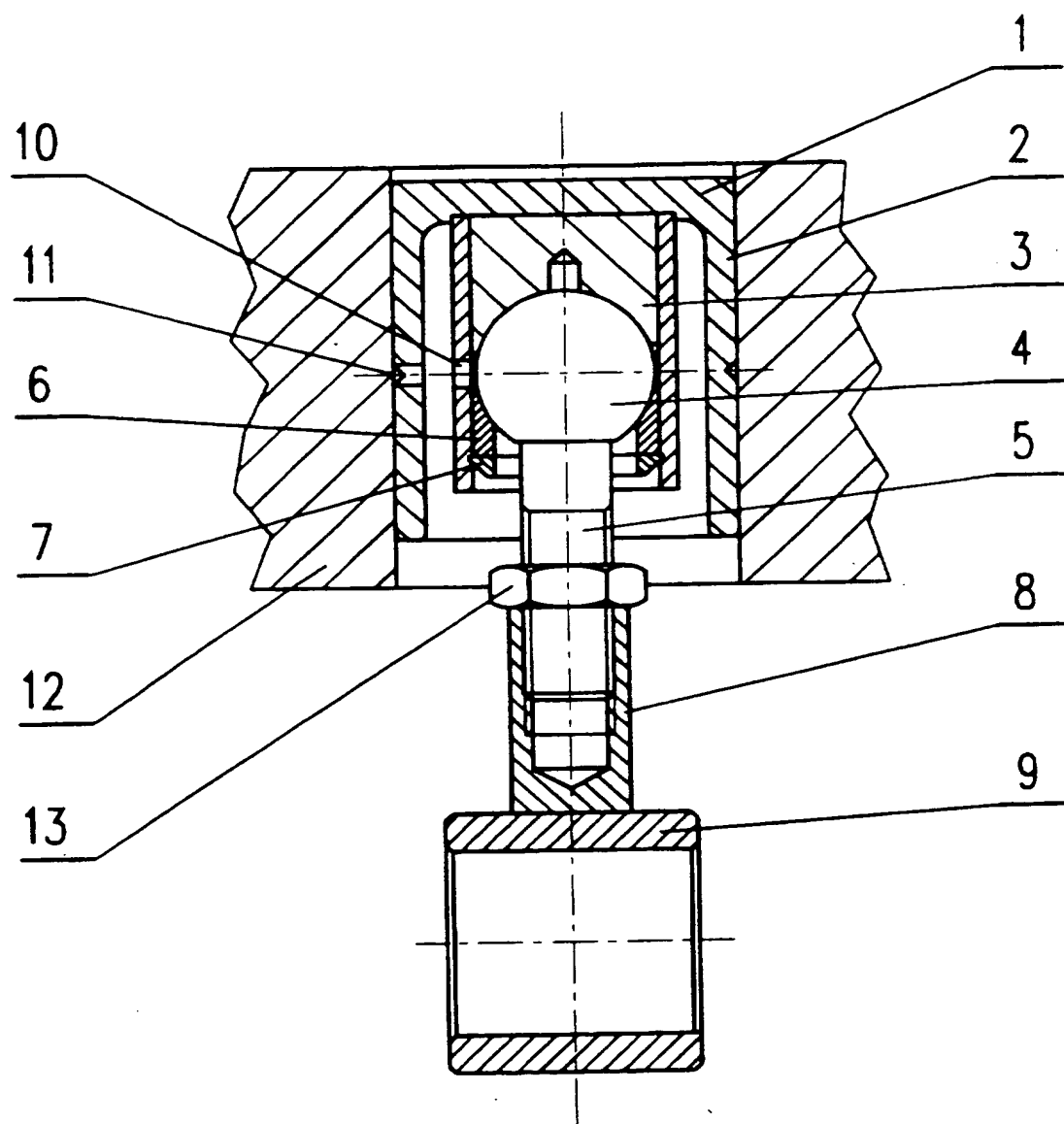


Fig.1

2/2

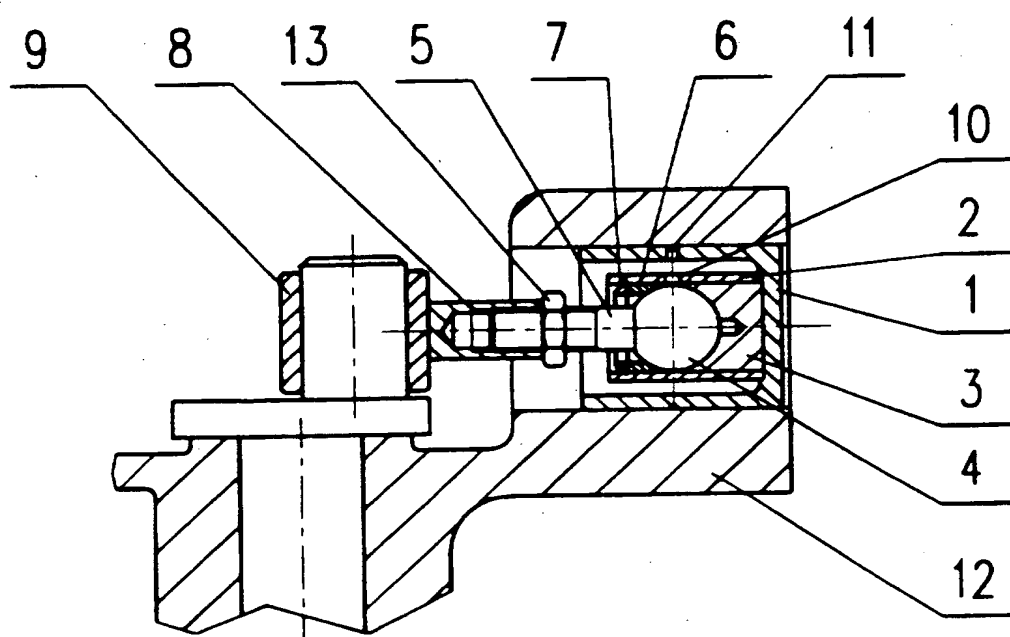


Fig.2

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP 95/00014

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16J1/22 F04B39/00 F04B39/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16J F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,3 482 487 (LEFFERS) 9 December 1969 see abstract; figures ---	1,4
A	CH,A,389 989 (SULZER) 30 July 1965 see page 2, line 1 - line 73; figures ---	1,2
A	DE,A,30 30 319 (VEB) 23 April 1981 cited in the application see page 4, line 7 - line 21; figures -----	1,4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

6 November 1995

Date of mailing of the international search report

16. 11. 95

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax (+31-70) 340-3016

Authorized officer

Narminio, A